

**Final Report for NASA Grant NAG2-855**  
**Total Project Period July 1, 1993 to March 31, 2000 entitled:**  
*Archiving of Planetary Ring Data*

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**Attention:**

NASA Washington Office, Accessioning Department

**FINAL REPORT FOR NASA GRANT NAG2-855**  
**MIT PARTICIPATION IN THE PDS RING NODE**  
(project end date: 2000-03-31)

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**GOAL OF THE PROJECT**

Stellar occultation data provide our only Earth-based means of probing planetary rings at kilometer spatial resolution. The occultation data archive at MIT contains original data and analysis products of stellar occultations by the ring systems of the planets Jupiter, Saturn, Uranus, and Neptune observed by members of the group (and other groups) from 1977 to the present. During this time period, several media have been used to record and store the original and processed data:

- (i) chart records,
- (ii) printed output,
- (iii) audio reel tape,
- (iv) audio cassette tape,
- (v) 7-track, 1/2-inch computer tape,
- (vi) 9-track, 1/2-inch computer tape at 800, 1600, and 6250 bpi,
- (vii) NOVA disk platters (2.5 and 5.0 Mbyte),
- (viii) write once optical disks,
- (ix) punched cards, and
- (x) read-write optical disks.

With the rapid change of computer technology over this time period, some of these media have become not only obsolete, but nearly extinct. In particular, it has become nearly impossible to find any facilities that can still read 800 bpi tapes, which contain the only copies of several important data sets for the ring system of Uranus. In particular, we have an extensive ring data collection that includes data sets for the following Uranian ring occultations: U0, U11, U12, U13, U14, U25, U17 and U36.

**COMPLETED WORK**

During this project we (i) searched our data tapes and found most of the Uranian data sets that we recorded during the 1970's and 80's, (ii) developed software needed to convert these files to FITS format, (iii) worked with the PDS node to develop a set of key words for our FITS headers, (v) supplied a Hubble Space Telescope for an occultation by Saturn's ring the following Uranus occultation data sets to the Planetary Data System:

Star	Occultation Date	Observatory
U0	1977-03-10	Kuiper Airborne Observatory
U11	1980-03-20	Cerro Tololo Inter-American Observatory
U12	1980-08-15	Cerro Tololo Inter-American Observatory
U12	1980-08-15	European Southern Observatory
U13	1981-04-26	Anglo-Australian Observatory
U14	1982-04-21	Cerro Tololo Inter-American Observatory
U15	1982-05-01	Mount Stromlo Observatory
U17	1983-03-25	South African Astronomical Observatory
U23	1985-05-04	Cerro Tololo Inter-American Observatory
U23	1985-05-04	McDonald Observatory
U23	1985-05-04	Teide Observatory
U25	1985-05-24	McDonald Observatory

These constitute the most important Uranus occultation data taken up through 1985, which have been used in the major ring-orbit analyses performed by Prof. Richard G. French of Wellesley College. All of the data sets were translated from old formats, some of which were unidentified when we started. Unfortunately, we were unable to find the original full data from the U13 and U15 events, but were able to provide extracts of the data encompassing the ring occultations. All of the data submitted are in FITS format, with a consistent set of header keywords. These keywords define the date and time of observation, the instrument, telescope, observatory and observers, approximate coordinates of the occulted star, integration time in the data series, published references to the observations and subsequent analyses of the data, and other comments that may be useful in interpreting the data. With the exception of U36, a huge data set that has not yet been completely analyzed and published, Dr. Bosh of Lowell Observatory and Prof. French should have most of the remaining Uranian-ring occultation data sets. We plan to eventually supply the U36 data set to the Rings Node, after this data set has been completely organized and published.

#### BIBLIOGRAPHY FOR ANALYSES OF THE SUBMITTED DATA SETS

- Elliot, J. L., A. S. Bosh, M. L. Cooke, R. C. Bless, M. Nelson, J. W. Percival, M. J. Taylor, G. W. Van Citters, J. F. Dolan, and E. L. Robinson 1992. A Saturn ring occultation observed with the Hubble Space Telescope. *EOS* **73**, 176.
- Elliot, J. L., R. G. French, J. A. Frogel, J. H. Elias, D. J. Mink, and W. Liller 1981. Orbita of nine Uranian rings. *Astron. J.* **86**, 444-455.
- Elliot, J. L., J. A. Frogel, J. H. Elias, I. S. Glass, R. G. French, D. Mink, and W. Liller 1981. The 20 March 1980 occultation by the Uranian rings. *Astron. J.* **86**, 127-134.
- Elliot, J. L., I. S. Glass, R. G. French, and J. A. Kangas 1987. The occultation of KME 17 by Uranus and its rings. *Icarus* **71**, 91-102.
- French, R. G., J. L. Elliot, and S. Levine 1986. Structure of the Uranian rings. II. Ring orbits and widths. *Icarus* **67**, 134-163.
- French, R. G., J. L. Elliot, L. M. French, J. A. Kangas, K. J. Meech, M. E. Ressler, M. W. Buie, J. A. Frogel, J. B. Holberg, J. J. Fuensalida, and M. Joy 1988. Uranian ring orbits from earth-based and voyager occultation observations. *Icarus* **73**, 349-378.